Bonding Basics

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This lesson was developed during Lindsay's student teaching experience.

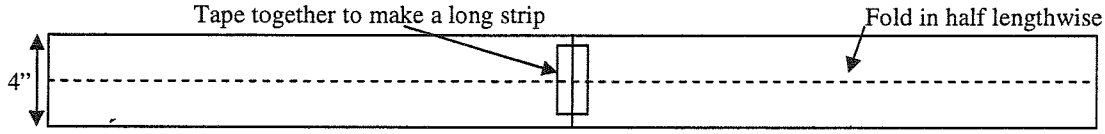
Lesson Objectives:
As a result of this lesson, students will be able to:
1 – Identify the number of valance electrons in a given atom.
2 – Describe and demonstrate how an ionic bond forms.
3 – Describe and demonstrate how a covalent bond forms.
4 – Predict the type of bond that will occur between two elements.

Materials Needed:
Construction Paper & Element Labels
Pipe Cleaners
Ping pong balls labeled with negative signs
Paperclips
Periodic Tables
Lesson Worksheets

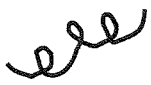
Preparation:

1 – Create a set of 18 atomic headbands. If you have a larger class, you may want to pair up the students for this activity. (See the note at the bottom of the page for an alternate idea!)

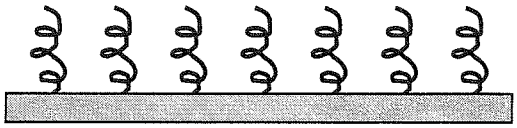
- Cut 4" strips length-wise from large pieces of white or colored construction paper. Tape the ends together to make one long strip. Laminate if possible and then fold in half lengthwise to make a band.



- Coil all of the pipe cleaners you need to make a spring-like structure. Most headbands will need 8 pipe cleaners except for Hydrogen, which needs only 2 pipe cleaners.

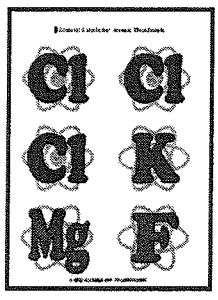


- Insert the ends of 8 pipe cleaners in the middle. Staple the pipe cleaners to the inside rim of the band to hold them in place. You will want to cover the inside rim with tape or strip of paper to prevent cuts from the staples.



- Bend the headband to make a circle and slide one end into the other. Use a paperclip to hold it in place.

- Print the Element Labels (pages 10-13) on card stock and laminate if possible. Use glue or staples to attach one label to the front of each headband. →



NOTE: Instead of making a class set of headbands, you can make a smaller set of only 8 headbands (4 with 8 pipe cleaners and 4 with only 2 pipe cleaners.). Cut out and laminate the Element Labels and then attach small squares of Velcro to each one. Attach the other piece of the Velcro fastener to the headbands. You can pick which elements you need and have the students help you add ping pong balls or "electrons" before creating the bond.

2 - Label ping pong balls with negative signs and use a compass point or other sharp object to make two small holes in each one. The holes need to be large enough to fit the diameter of the pipe cleaner, but small enough that the ping pong balls won't fall off. Sort the ping pong balls into Ziploc bags with 8 per bag. You will need a few bags with just 2 balls for the Hydrogen atoms.

Lesson Directions:

Step 1 – Distribute headbands and bags of ping pong balls to each student or groups of students.

Step 2 - Instruct the students to add ping pong balls to the headbands to represent the number of valence electrons that are in each atom.

Step 3 – Have students work together to complete Section A on their worksheet related to valence electrons and oxidation numbers and then discuss their answers. They will need to use a periodic table to complete the chart.

Step 4 – Review the basics of ionic bonds by completing the information in Part B.

Step 5 – Demonstrate the formation of an ionic bond using the elements in Example B1. Ask the students with the headbands for Sodium and Chlorine to come to the front of the classroom. Ask the students the following questions as you demonstrate the bond:

1 – How many valance electrons does Sodium have? (1)

2 – How many valence electrons does Chlorine have? (7)

3 – How many electrons does Chlorine need to complete its outer shell? (1)

4 – How many electrons does Sodium need to lose to be left with a complete shell? (1)

DO: Have the student with the Sodium headband remove the ping pong ball (electron) and place it on a pipe cleaner on the Chlorine headband.

5 – Since Sodium lost one electron, what is its charge? (1+)

6 - What do we call a positively charged ion? (cation)

7 – Since Chlorine gained one electron, what is its charge? (1-)

8 - What do we call a negatively charged ion? (anion)

9 – Do the charges balance? (Yes)

10 - What is the chemical formula for this compound? (NaCl)

11 – What is the name of this compound? (Sodium Chloride or salt.)

DO: Review the formation of the bond by drawing the Lewis structures for the elements and use an arrow to show the transfer of electrons from Sodium to Chlorine. Finish the example by writing the chemical formula with the charges and without. (Note: See the answer key for more details.)

Step 6 – Repeat this process for the other ionic bond examples. Some of the compounds will require more than two students to participate. Once your students have the basic idea they may be able to draw the bond structures on their own.

Step 7 – Discuss the information about covalent bonds in Part C.

Step 8 - Demonstrate the formation of a covalent bond using the element in Example C1. Ask the students with the Hydrogen headbands to come to the front of the classroom. Ask the students the following questions as you demonstrate the bond:

1 – How many valance electrons does Hydrogen have? (1)

2 – How many electrons does Hydrogen need to have a complete shell? (1)

DO: Since Hydrogen isn't likely to give up an electron, it must share one with another atom. Have the students stand close to one another and "share" the electrons. Demonstrate this by placing the pipe cleaner from one headband into the "electron" on the other headband. Repeat for the second electron so both students are attached to one another.

3 – How many electrons does each Hydrogen atom now have? (2 – 1 of its own and 1 that is shared)

DO: Use your hand to "draw" a circle around a Hydrogen atom and the two electrons it has in its outer shell. You could also use rope or string to form a circle around each atom and it's electrons.

4 - What is the chemical formula for this compound? (H_2)

5 – What type of covalent compound is this? (Diatomic)

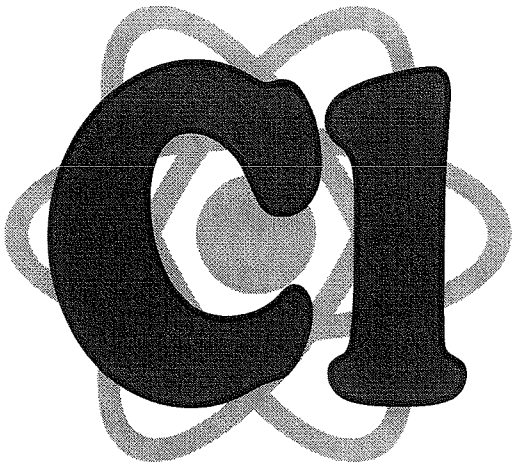
DO: Review the formation of the bond by drawing the Lewis structures for the elements and use circles to show how the electrons are shared between the two atoms. Finish the example by writing the chemical formula. (Note: See the answer key for more details.)

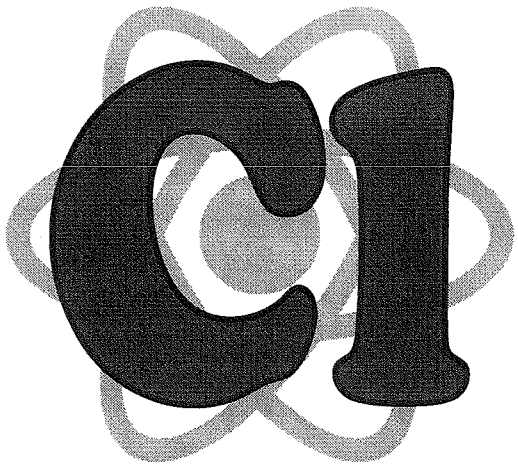
Note: In my experience, the covalent bonds are the most difficult for students to visualize so you may want to do most of these together and discuss each one.

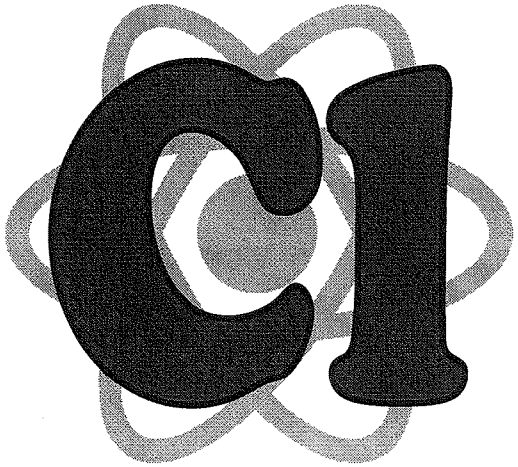
Also available ...

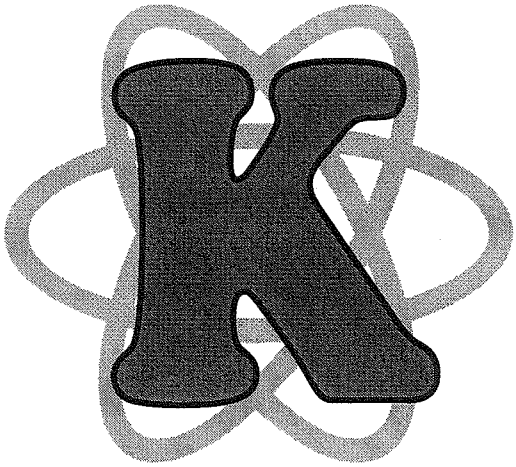
The original Bonding Basics lesson is available at http://sciencespot.net/Pages/classchem.html#Anchorbond. The answer keys for the ionic and covalent worksheets have more details about each bond that may help if you have questions about how to demonstrate them to your students.

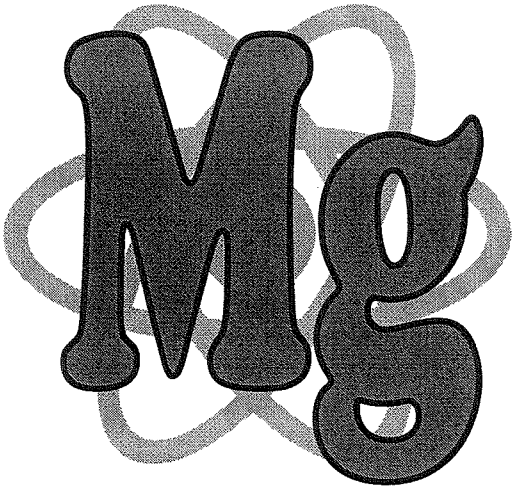
Element Labels for Atomic Headbands

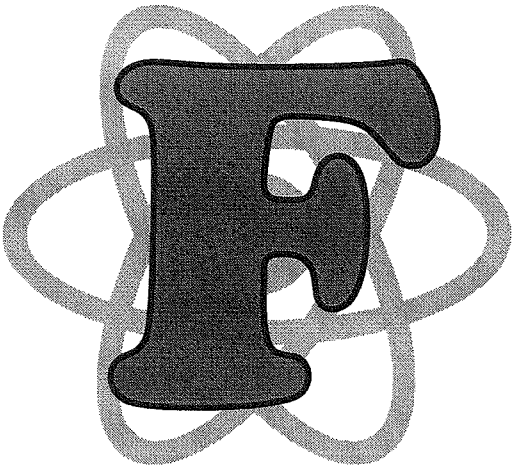












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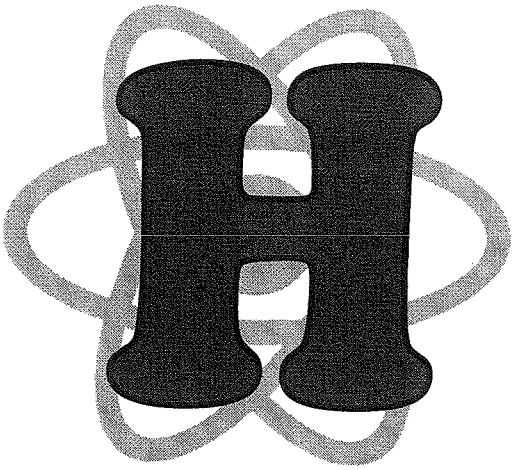

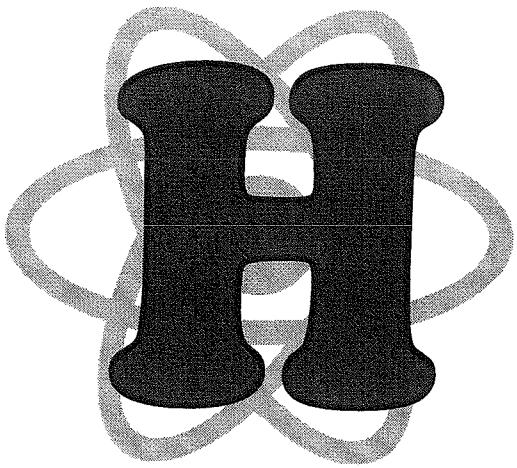

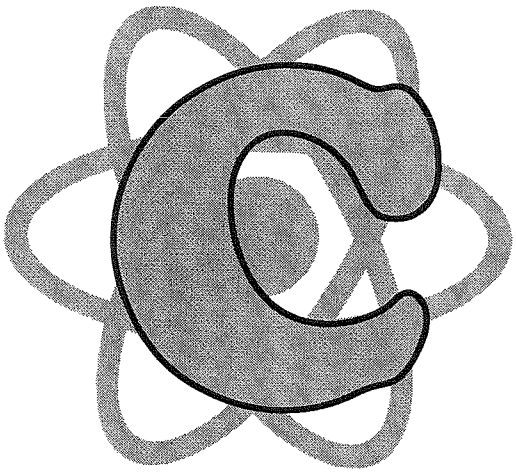

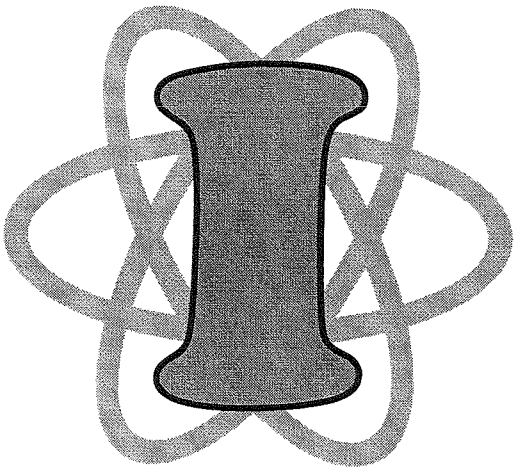

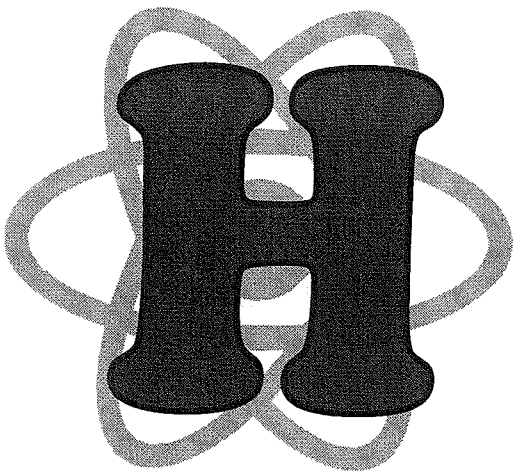

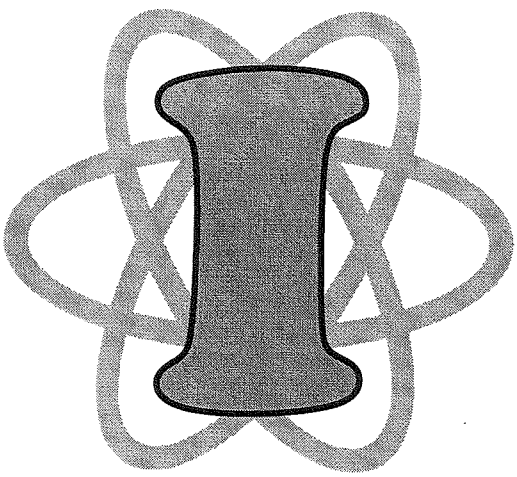

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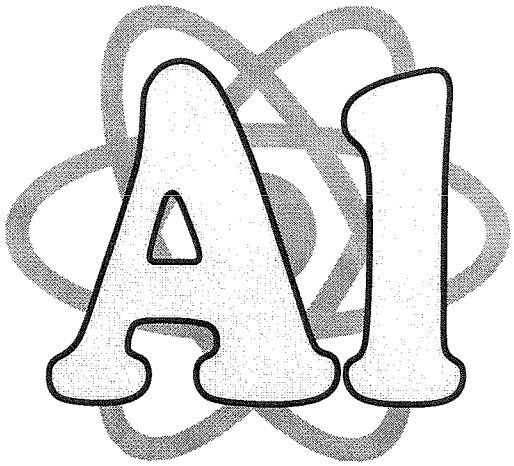

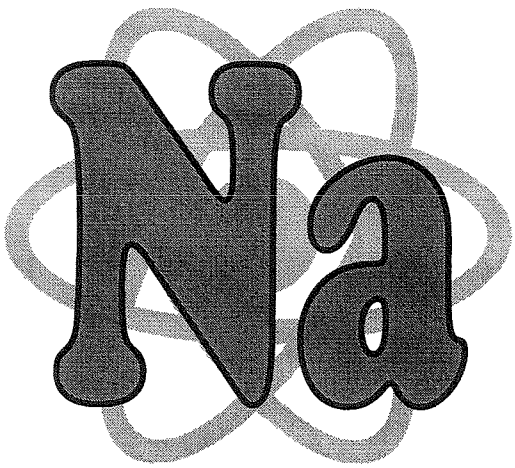

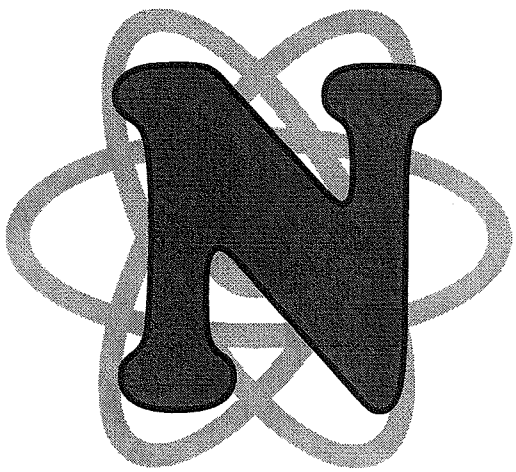

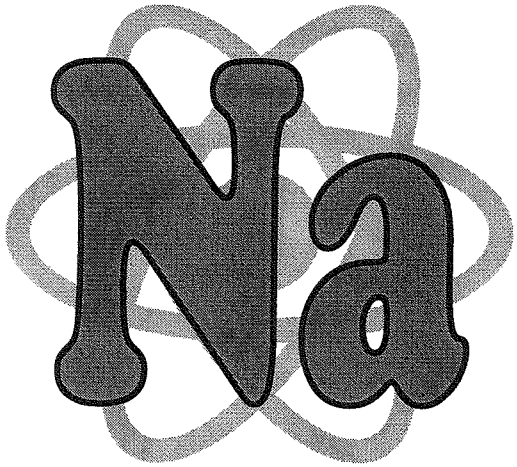

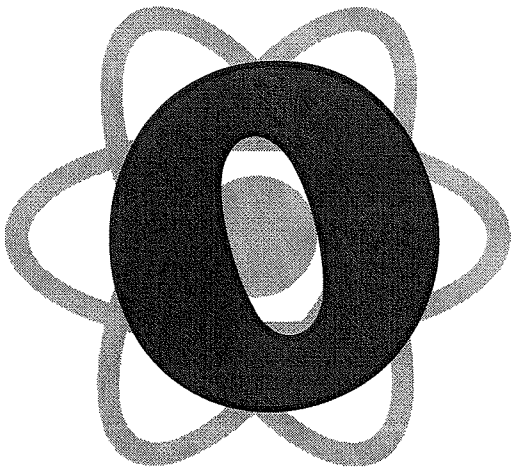

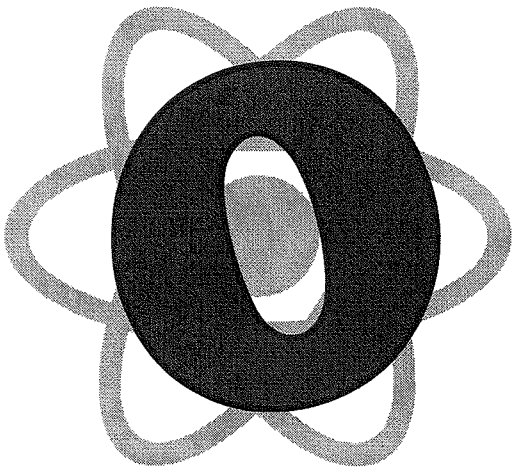

Element Labels for Atomic Headbands

Extra Labels – Laminate and use a dry erase marker to make any element you need.